

## WHAT IS CLAIMED IS:

1. An apparatus for determining linearity of tire characteristic comprising:  
a standard vehicle behavior arithmetic unit that calculates a standard  
5 vehicle behavior indicator based upon at least one of an operation amount of an  
operation unit with which a driver of a traveling vehicle performs a steering operation  
and an actually steered amount of steerable wheels of the traveling vehicle, wherein  
the operation amount of the operation unit is detected by an operation amount detector  
and the actually steered amount of the steerable wheels is detected by a steered amount  
10 detector; and  
a tire characteristic linearity determination unit that compares an actual  
vehicle behavior indicator detected by a vehicle behavior detector with the standard  
vehicle behavior indicator, to determine whether tires of the traveling vehicle stand in  
a linear region or in a non-linear region of the tire characteristic.  
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2. An apparatus for determining linearity of tire characteristic according to  
claim 1, wherein the tire characteristic linearity determination unit includes:  
a vehicle behavior deviation change rate arithmetic part that calculates a  
vehicle behavior deviation by subtracting the actual vehicle behavior indicator from  
20 the standard vehicle behavior indicator, and calculates a rate of change of the vehicle  
behavior deviation;  
a sign determination part that determines a first sign of one of the  
vehicle behavior deviation and the rate of change of the vehicle behavior deviation,  
and a second sign of the actual vehicle behavior indicator;  
25 a tire characteristic linearity determination part that determines linearity  
of tire characteristic, wherein if the first and second signs are both positive and the

rate of change of the vehicle behavior deviation is greater than a first prescribed value, and if the first and second signs are both negative and the rate of change of the vehicle behavior deviation is less than a second prescribed value, it is determined that the tires of the traveling vehicle stand in the non-linear region of the tire characteristic.

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3. A program for determining linearity of tire characteristic, which causes a computer to execute a process to determine whether tires of a traveling vehicle stand in a linear region or in a non-linear region of the tire characteristic, the process comprising the steps of:

10 receiving at least one of an operation amount of an operation unit with which a driver of the traveling vehicle performs a steering operation and an actually steered amount of steerable wheels of the traveling vehicle, which are detected by an operation amount detector and a steered amount detector, respectively;

calculating a standard vehicle behavior indicator based upon the at least  
15 one of the operation amount of the operation unit and the actually steered amount of the steerable wheels;

receiving an actual vehicle behavior indicator detected by a vehicle behavior detector;

calculating a vehicle behavior deviation by subtracting the actual vehicle  
20 behavior indicator from the standard vehicle behavior indicator;

calculating a rate of change of the vehicle behavior deviation;

determining a first sign of one of the vehicle behavior deviation and the rate of change of the vehicle behavior deviation, and a second sign of the actual vehicle behavior indicator;

25 if the first and second signs are both positive and the rate of change of the vehicle behavior deviation is greater than a first prescribed value, determining that

the tires of the traveling vehicle stand in the non-linear region of the tire characteristic; and

if the first and second signs are both negative and the rate of change of the vehicle behavior deviation is less than a second prescribed value, determining that  
5 the tires of the traveling vehicle stand in the non-linear region of the tire characteristic.

4. A vehicular driving operation apparatus comprising:

an operation unit with which a driver of a traveling vehicle performs a steering operation;

10 a steering amount detection unit including at least one of an operation amount detector that detects an operation amount of the operation unit and a steered amount detector that detects an actually steered amount of steerable wheels of the traveling vehicle;

a steering motor that drives the steerable wheels to be steered;

15 a control unit that controls the steering motor based upon at least one of the operation amount of the operation unit and the actually steered amount of the steerable wheels;

a vehicle behavior detector that detects an actual vehicle behavior indicator;

20 an apparatus for determining linearity of tire characteristic according to claim 1; and

a steering amount reduction control unit that controls the steering motor so that the steering motor drives the steerable wheels to be steered back if the tire characteristic linearity determination unit determines that the tires of the traveling  
25 vehicle stand in the non-linear region of the tire characteristic.

5. A vehicular driving operation apparatus comprising:

an operation unit with which a driver of a traveling vehicle performs a steering operation;

a reaction force motor that gives a reaction force against operation of the operation unit;

a steering amount detection unit including at least one of an operation amount detector that detects an operation amount of the operation unit and a steered amount detector that detects an actually steered amount of steerable wheels of the traveling vehicle;

a steering motor that drives the steerable wheels to be steered;

a control unit that controls the steering motor based upon at least one of the operation amount of the operation unit and the actually steered amount of the steerable wheels;

a vehicle behavior detector that detects an actual vehicle behavior indicator;

an apparatus for determining linearity of tire characteristic according to claim 1; and

a steering amount reduction control unit that controls the reaction force motor so that the reaction force motor drives the operation unit to move back toward a neutral position if the tire characteristic linearity determination unit determines that the tires of the traveling vehicle stand in the non-linear region of the tire characteristic.

6. A steering control method for a steer-by-wire vehicle having a steer-by-wire system which includes an operation unit with which a driver performs a steering operation, a steering motor that drives steerable wheels to be steered, and a reaction

force motor that gives a reaction force against operation of the operation unit, to perform a steering operation through electric connections, the method comprising:

calculating a standard vehicle behavior indicator based upon at least one of an operation amount of the operation unit and an actually steered amount of the steerable wheels;

comparing an actual vehicle behavior indicator obtained by detection with the standard vehicle behavior indicator, to determine whether tires of the vehicle during traveling stand in a linear region or in a non-linear region of tire characteristic; and

if it is determined that the tires of the traveling vehicle stand in the non-linear region of the tire characteristic, controlling at least one of the reaction force motor and the steering motor to steer the steerable wheels toward such a direction as to reduce the steering amount thereof.